Claims

1. Drill (4) with a drill head (5) with a diameter D (51), in which the drill head (5) on a drill tip (13) has only one cutting edge (52) extending over part of the diameter D (51), and with a lateral, V-shaped chip removing groove or bead (59) and with a channel (12) with an outlet opening (56) in the drill head (5) for supplying a drill fluid (9), wherein on a drill side (61) of the drill head (5) facing away from the bead (59) between a first and a second cylinder casing part surface (64, 65) of the drill head (5) there is a rear offset (63) reducing the cross section of the drill head (5) relative to an enclosing cylinder casing surface (62) of the drill head (5).

2. Drill according to claim 1, wherein a ratio of the length of the drill head (5) to its diameter D (51) has a value from a range of 0.5 to 10.

3. Drill according to claim 2, wherein the ratio of the length of the drill head (5) to its diameter D (51) has a value from a range of 1 to 4.

4. Drill according to one of claims 1 to 3, wherein a normal to the surface (67) of the rear offset (63) with an angle-halving end (68) of the bead (59) encloses and angle (69), whereby said angle (69) has a value from a range of from – 50° to + 50°, preferably from a range of from – 30° to + 30°.

5. Drill according to one of claims 1 to 4, wherein the rear offset (63) is arranged in an end region (74) of the drill head (5) facing the drill tip (13) and extends in axial direction.

6. Drill according to one of claims 1 to 5, wherein the rear offset (63) has a width (70), whereby the ratio of the diameter D(51) and the width (70) has a value from a range of 0.1 to 0.8.

7. Drill according to one of claims 1 to 6, wherein the rear offset (63) runs continuously in the direction of the drill tip (13).

8. Drill according to one of claims 1 to 7, wherein the rear offset (63) is aligned parallel in relation to a drill axis (27) of the drill head (5).

9. Drill according to one of claims 1 to 8, wherein two or more rear offsets (63) are formed spaced apart from one another by interlying cylinder casing part surfaces (64, 65).

10. Drill according to one of claims 1 to 9, wherein the drill head (5) is designed to have a cutting edge (52) with a first cutting edge section (53) and with a second cutting edge section (54), whereby the first cutting edge section (53) faces a drill axis (27) of the drill head (5) and the second cutting edge section (54) faces away from the drill axis (27) of the drill head (5), and the first cutting edge section (53) with the drill axis (27) encloses a first cutting edge angle (71) of at least 70°.

11. Drill according to claim 10, wherein the first cutting edge angle (71) is at least 80°.

12. Drill according to claim 10 or 11, wherein the second cutting edge section (54) with the drill axis (27) encloses a second cutting edge angle (71), whereby the second cutting edge angle (71) has a value from a range of 20° to 90°.

13. Drill according to claim 12, wherein the second cutting edge angle (71) has a value from a range of 35° to 80°.

14. Drill according to one of claims 10 to 13, wherein a cutting edge tip (55) formed by the two cutting edge sections (53, 54) has a minimal edge distance (73) relative to an enclosing cylinder casing surface (62) of the drill head (5), which has a value from a range of 1/10 to 1/3 of diameter D (51).

15. Drill according to clam 14, wherein the edge distance (73) has a value from a range of 1/5 to 1/4 of the diameter D (51).

16. Drill according to one of claims 10 to 15, wherein an end region (74) of the second cutting edge section (54) facing away from the drill axis (27) of the drill head (5) or the

cutting edge tip (55) is designed to be rounded towards the enclosing cylinder casing surface (62) of the drill head (5).

17. Drill according to claim 16, wherein the end region (74) of the second cutting edge section (54) facing away from the cutting edge tip (55) has a radius of curvature (75) of up to ½ the diameter D (51).

18. Drill according to one of claims 1 to 17, wherein the diameter D(51) of the drill head (5) has a value from a range of 3 mm to 40 mm.

19. Drill according to one of claims 1 to 18, wherein the diameter D (51) of the drill head (5) has a value from a range of 4 mm to 20 mm.

20. Drill according to one of claims 1 to 19, wherein a second outlet opening (76) is arranged in a surface area (77) of the drill head (5) formed by the rear offset (63).

21. Drill according to claim 20, wherein an opening axis (58) of the second outlet opening (76) is inclined in relation to the normal to the surface (67) of the rear offset (63).

22. Drill according to claim 21, wherein an angle of inclination (79) of the opening axis (58) relative to the normal to surface (67) of the rear offset (63) has a value from a range of 0° to 80°.

23. Drill according to claim 21, wherein the angle of inclination (79) of the opening axis (58) has a value from a range of 30° to 60°.

24. Drill according to claim 23, wherein the second outlet opening (76) is in an area of the drill head (5) closer to the drill tip (13) and a further outlet opening (56) is arranged in a surface area (77) of the drill head (5) formed by the bead (59), whereby said further outlet opening (56) lies in a region of the drill head (5) positioned further away from the drill tip (13).

25. Drill according to one of claims 1 to 19, wherein on the drill side (61) of the drill head (5) facing away from the bead (59) or in the rear offset (63) a piezoelectric element (105) is arranged.

26. Drill according to claim 25, wherein the piezoelectric element (105) is designed to have a bearing side (109), whereby the bearing side (109) is designed to be in alignment with the enclosing cylinder casing surface (62) of the drill head (5).

27. Drill according to one of claims 1 to 26, wherein the drill head (5) has an element (110) emitting electromagnetic radiation.

28. Drill according to claim 27, wherein the element (110) emitting electromagnetic radiation is formed by a piece of a chemical element emitting gamma radiation.

29. Device (1) for drilling a borehole (2) in a workpiece (3) with a diameter D (51) of a drill (4) and a depth (35) of the borehole (2), whereby the ratio of the depth (35) to the diameter D (51) is greater than 100, with a drill spindle (7) and with a drill (4) comprising a drill head (5), a drill shaft (6) and a channel (12) for supplying a drill fluid (9) and with a drill fluid circuit (8) for the drill fluid (9), whereby the drill fluid circuit (8) comprises at least one pump (11) and a supply line (18) and with a rotary transfer (17) on the drill spindle (7) for supplying the drill fluid (9) into the channel (12) of the drill (4), wherein the device (1) comprises a drill (4) according to one of claims 1 to 24.

30. Device according to claim 29, wherein the drill fluid circuit (8) comprises a pulse line (25) with a valve (26), whereby the pulse line (25) branches off from the supply line (18) immediately prior to rotary transfer (17).

31. Device according to claim 30, wherein the valve (26) is in the form of a servovalve.

32. Device according to one of claims 29 to 31, wherein the drill fluid circuit (8) comprises a filter device with a coarse filter (15) and/or a fine filter (16) for the drill fluid (9).

33. Device according to one of claims 30 to 32, wherein at least the supply line (18) and/or the pulse line (25) of the drill fluid circuit (8) are formed by lines (106) with high resistance to radial and longitudinal extension.

34. Device according to one of claims 29 to 33, wherein the drill fluid circuit (8) is designed for drill fluid (9) pressure of in the region of up to 60 bar.

35. Device according to claim 34, wherein the drill fluid circuit (8) is designed for drill fluid (9) pressure of in the region of up to 160 bar.

36. Device according to claim 34, wherein the drill fluid circuit (8) is designed for drill fluid (9) pressure of in the region of up to 300 bar.

37. Device according to claim 34, wherein the drill fluid circuit (8) is designed for drill fluid (9) pressure of in the region of up to 600 bar.

38. Device according to claim 34, wherein the drill fluid circuit (8) is designed for drill fluid (9) pressure of in the region of up to 4,000 bar.

39. Device according to claim 34, wherein the drill fluid circuit (8) is designed for drill fluid (9) pressure of in the region of more than 4,000 bar.

40. Device according to one of claims 29 to 39, wherein the latter comprises a rotary sensor (28) for measuring the rotational speed or the angular speed of the drill (4) and the current position of a cutting edge (52) of the drill (4).

41. Device according to one of claims 29 to 40, wherein a measuring device (30) is provided for measuring the longitudinal dimension of the borehole (2).

42. Device according to claim 41, wherein it includes a control device (29), which is connected to the rotary sensor (28), the measuring device (30) and the valve (26).

43. Device according to one of claims 29 to 42, wherein the measuring device (30) comprises a measuring head support (34) for changing the spatial position and the alignment of a measuring head (31).

44. Device according to claim 43 wherein the measuring device (30) comprises a position measuring device for measuring the spatial position of the measuring head support and the measuring head (31).

45. Device according to claim 43 or 44, wherein on the measuring head support at least one ultrasound transmitter (36) and at least one ultrasound receiver (37) are arranged.

46. Device according to claim 45, wherein the ultrasound transmitter (36) and the ultrasound receiver (37) are arranged in a common ultrasound measuring head.

47. Device according to one of claims 43 to 44, wherein on the measuring head support (34) a radiation detector (108) is arranged for measuring electromagnetic radiation, and in the drill head (5) an element (110) emitting electromagnetic radiation is arranged.

48. Device according to claim 47, wherein the radiation detector (108) is designed at least for measuring the intensity of gamma radiation, and the element (110) is formed by a piece of a chemical element emitting gamma radiation.

49. Device according to one of claims 29 to 48, wherein the latter comprises a drill (91) with a drill bush (94) and drill bush shaft (93), whereby in the drill bush (94) an eccentrically arranged drill guiding hole (95) is formed.

50. Device according to claim 49, wherein the drill guiding hole (95) is inclined relative to a longitudinal middle axis (96) of the drill bush (94).

51. Device according to claim 49 or 50, wherein an axis (97) of the drill guiding hole (95) and the longitudinal middle axis (96) of the drill bush (94) enclose an angle of inclination (79), the value of which is selected from a range of between 0° and 5°.

52. Device according to claim 51, wherein the angle of inclination (79) between the axis (97) of the drill guiding hole (95) and the longitudinal middle axis (6) of the drill bush (94) is selected from a range of between 0.5° and 1.5°.

53. Device for drilling a borehole (2) in a workpiece (3) with a diameter D (51) of a drill (4) and a depth (35) of the borehole (2), whereby the ration of depth (35) to diameter D (51) is greater than 100, with a drill spindle (7) and a drill (4) comprising a drill head (5), a drill shaft (6) and a channel (12) for supplying drill fluid (9), and with a drill fluid circuit (8) for the drill fluid (9), whereby the drill fluid circuit (8) comprises at least one pump (11) and a supply line (18) and with a rotary transfer (17) on the drill spindle (7) for supplying drill fluid (9) into the channel (12) of the drill (4), wherein the device (1) comprises a drill (4) according to one of claims 25 to 28.

54. Device according to claim 53, wherein the latter comprises a rotary sensor (28) for measuring the speed or the angular speed of the drill (4) and the current position of a cutting edge (52) of the drill (4).

55. Device according to claim 53 or 54, wherein a measuring device (30) is designed to measure the longitudinal dimension of the borehole (2).

56. Device according to one of claims 53 to 55, wherein it includes a control device (29), which is connected with the rotary sensor (28) and the measuring device (30).

57. Device according to one of claims 53 to 56, wherein the measuring device (30) comprises a measuring head support (34) for changing the spatial position and the alignment of a measuring head (31).

58. Device according to claim 57, wherein the measuring device (30) comprises a position measuring device for measuring the spatial position of the measuring head support (34) and the measuring head (31).

59. Device according to claim 57 or 58, wherein on the measuring head support (34) at

least one ultrasound transmitter (36) and at least one ultrasound receiver (37) are arranged.

60. Device according to claim 59, wherein the ultrasound transmitter (36) and the ultrasound receiver (37) are arranged in a common ultrasound measuring head.

61. Device according to claim 57 or 58, wherein on the measuring head support (34) a radiation detector (108) is arranged for measuring electromagnetic radiation and in the drill head (5) an element (110) emitting electromagnetic radiation is arranged.

62. Device according to claim 61, wherein the radiation detector (108) is designed at least for measuring the intensity of gamma radiation and the element (110) is formed by a piece of a chemical element emitting gamma radiation.

63. Device according to one of claims 53 to 62, wherein the latter comprises a drill pipe (91) with a drill bush (94) and drill bush shaft (93), whereby in the drill bush (94) an eccentrically arranged drill guiding hole (95) is formed.

64. Device according to one of claims 53 to 63, wherein the drill guiding hole (95) is aligned to be inclined relative to a longitudinal middle axis (96) of the drill bush (94).

65. Device according to one of claims 53 to 64, wherein an axis (97) of the drill guiding hole (95) and the longitudinal middle axis (96) of the drill bush (94) enclose an angle of inclination (79) which is selected from a range of between 0° and 5°.

66. Device according to one of claims 53 to 65, wherein the angle of inclination (79) between the axis of the drill guiding hole (5) and the longitudinal middle axis (96) of the drill bush (94) is selected from a range of between 0.5° and 1.5°.

67. Method for drilling deep boreholes in workpieces (3) with a drill (4) with a drill head (5) with a diameter D (51) and a depth (35) of the borehole (2),whereby the ratio of the depth (35) to the diameter D (51) is greater than 100, wherein on the drill head (5) a radial force (19) is exerted that acts periodically over a predeterminable rotational angle range.

68. Method according to claim 67, wherein during the drilling process the longitudinal dimension of the borehole (2) is measured.

69. Method according to claim 68, wherein the longitudinal dimension of the borehole (2) is measured by means of ultrasound.

70. Method according to claim 68, wherein the longitudinal dimension of the borehole (2) is measured by means of electromagnetic radiation.

71. Method according to claim 70, wherein the longitudinal dimension of the borehole (2) is measured by means of a gamma radiation transmitter arranged on the drill head (5) of the drill (4).

72. Method according to one of claims 67 to 71, wherein from the values taken from measuring the longitudinal dimension of the borehole (2) the direction and the extent of the average deviation of the borehole (2) are calculated.

73. Method according to one of claims 67 to 72, wherein a measurement is taken of the speed or angular velocity and current position or alignment of a cutting edge (52) of the drill (4).

74. Method according to claim 73, wherein from the current position or alignment of the cutting edge (52)of the drill (4) and the direction and extent of the average deviation of the borehole (2) a time characteristic of the periodic change in radial force (19) is calculated.

75. Method according to claim 74, wherein the ratio of a frequency corresponding to the rotation of the drill (4) and a frequency of the time characteristic of the periodic change in the radial force (19) is an integer.

76. Method according to claim 75, wherein the frequency relating to the rotation of the drill (4) and the frequency of the time characteristic of the periodic change of radial force (19) are equal.

77. Method according to one of claims 67 to 76, wherein the drilling procedure using the drill (4) with diameter D(51) is interrupted and drilling is continued with a drill (92) with a diameter (99), which is smaller than diameter D (51) and which is guided in an eccentrically arranged drill guiding hole (95) of a drill pipe (91), whereby a drill bush (94) of the drill pipe (91) has an external diameter (98), which is slightly smaller than diameter D (51).

78. Method according to claim 77, wherein the drill guiding hole (95) is aligned obliquely relative to a longitudinal middle axis (96) of the drill bush (94).

79. Method according to claim 77 or 78, wherein an axis (97) of the drill guiding hole (95) and the longitudinal middle axis (96) of the drill bush (94) enclose an angle of inclination (79), which is selected from a range of between 0° and 5°.

80. Method according to claim 79, wherein the angle of inclination (79) between the axis of the drill guiding hole (5) and the longitudinal middle axis (96) of the drill bush (94) is selected from a range of between 0.5° and 1.5°.

81. Method according to one of claims 67 to 80, wherein the radial force (19) is obtained by a periodic change in pressure of a drill fluid (9), which is supplied during the drilling procedure into the area of the drill head (5).

82. Method according to claim 81, wherein the drill fluid (9) is fed through a channel (12) with at least one outlet opening (56) in the drill head (5).

83. Method according to claim 81 or 82, wherein at least a partial flow of the drill fluid (9) is directed in a discharge direction against a lateral interior wall of the borehole (2).

84. Method according to one of claims 81 to 83, wherein for the drill (4) with diameter D (51) a drill according to one of claims 1 to 24 is used.

85. Method according to one of claims 81 to 84, wherein the pressure of the drill fluid (9) is changed according to the calculated time characteristic.

86. Method according to one of claims 81 to 85, wherein the change in pressure is carried out by controlling a valve (26) that reduces the pressure.

87. Method according to claim 86, wherein a servovalve is used for the valve (26).

88. Method according to one of claims 81 to 87, wherein to supply the drill fluid (9) to the drill (4) lines (106) are used that are highly resistant to radial and longitudinal extension or have a high elasticity module.

89. Method according to one of claims 81 to 88, wherein the pressure used is in the region of at least 60 bar.

90. Method according to claim 89, wherein the pressure used is in the region of at least 160 bar.

91. Method according to claim 90, wherein the pressure used is in the region of at least 300 bar.

92. Method according to claim 91, wherein the pressure used is in the region of at least 600 bar.

93. Method according to claim 92, wherein the pressure used is in the region of at least 4,000 bar.

94. Method according to one of claims 81 to 93, wherein the drill fluid (9) used has a viscosity at 40° C of in the region of a maximum of 30 mm^2/s.

95. Method according to claim 94, wherein the drill fluid (9) used has a viscosity at 40°C of in the region of a maximum of 22 mm^2/s.

96. Method according to one of claims 67 to 80, wherein a drill according to one of claims 25 to 28 is used as the drill (4) with diameter D (51).

97. Method according to claim 96, wherein the radial force (19) is exerted by means of a periodically changing pressure which is generated by a piezoelectric element (105) arranged on the drill (4).